

# Direct Survival of Migrating Salmonid Smolts in the Snake and Lower Columbia Rivers: Update with 2008 Results

**Technical Management Team**  
**Lessons Learned 2008**

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**Steve Smith**

**[steven.g.smith@noaa.gov](mailto:steven.g.smith@noaa.gov)**

**Bill Muir**

**[bill.muir@noaa.gov](mailto:bill.muir@noaa.gov)**

**John Williams**

**[john.g.williams@noaa.gov](mailto:john.g.williams@noaa.gov)**

**Jim Faulkner**

**[jim.faulkner@noaa.gov](mailto:jim.faulkner@noaa.gov)**



# Outline

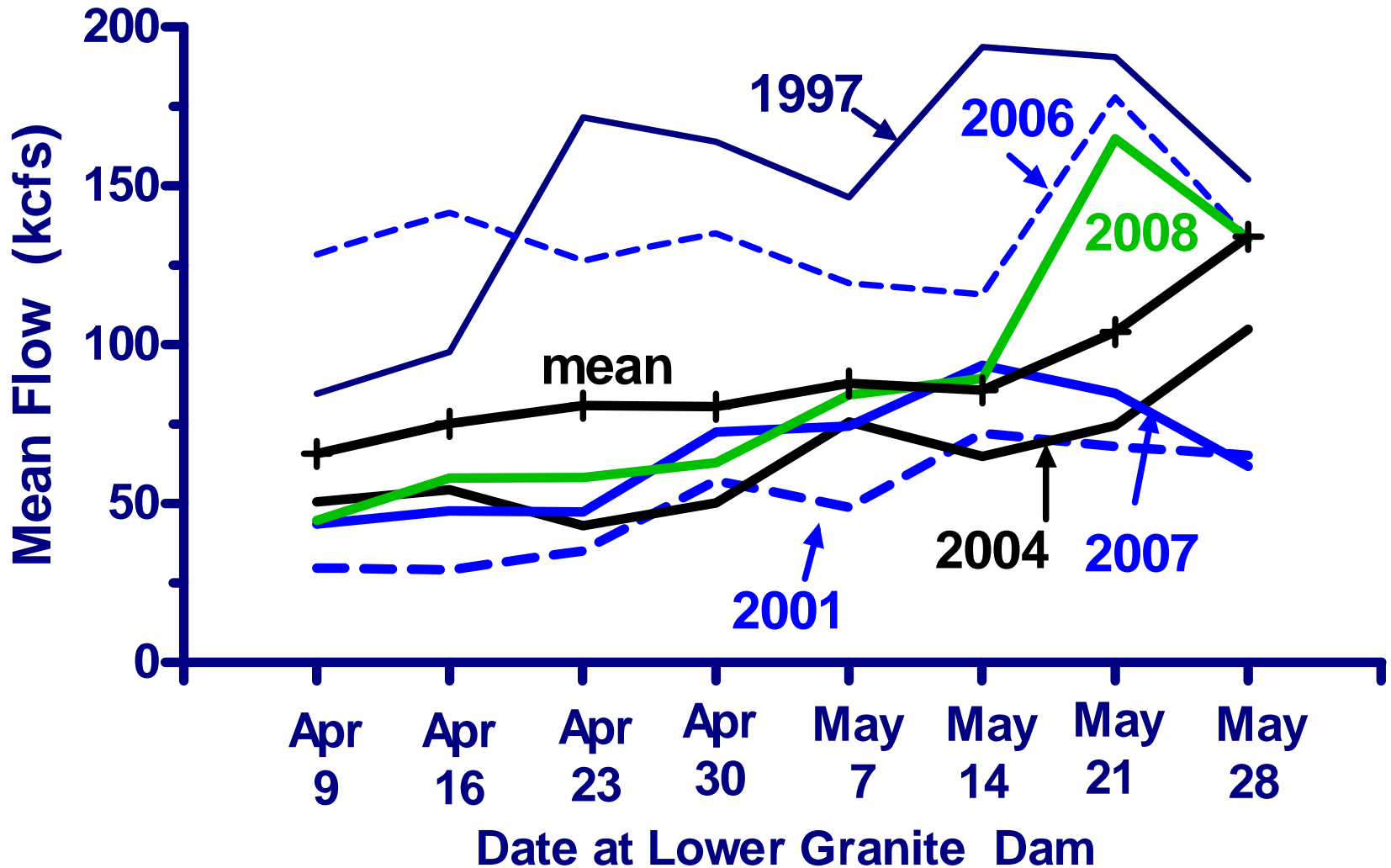
- Juvenile survival and travel time through the hydropower system
- Percentage transported
  - Update with 2008 results
    - Annual summer “survival memo” released 8 September 2008
    - Draft Final Report in prep

# Outline

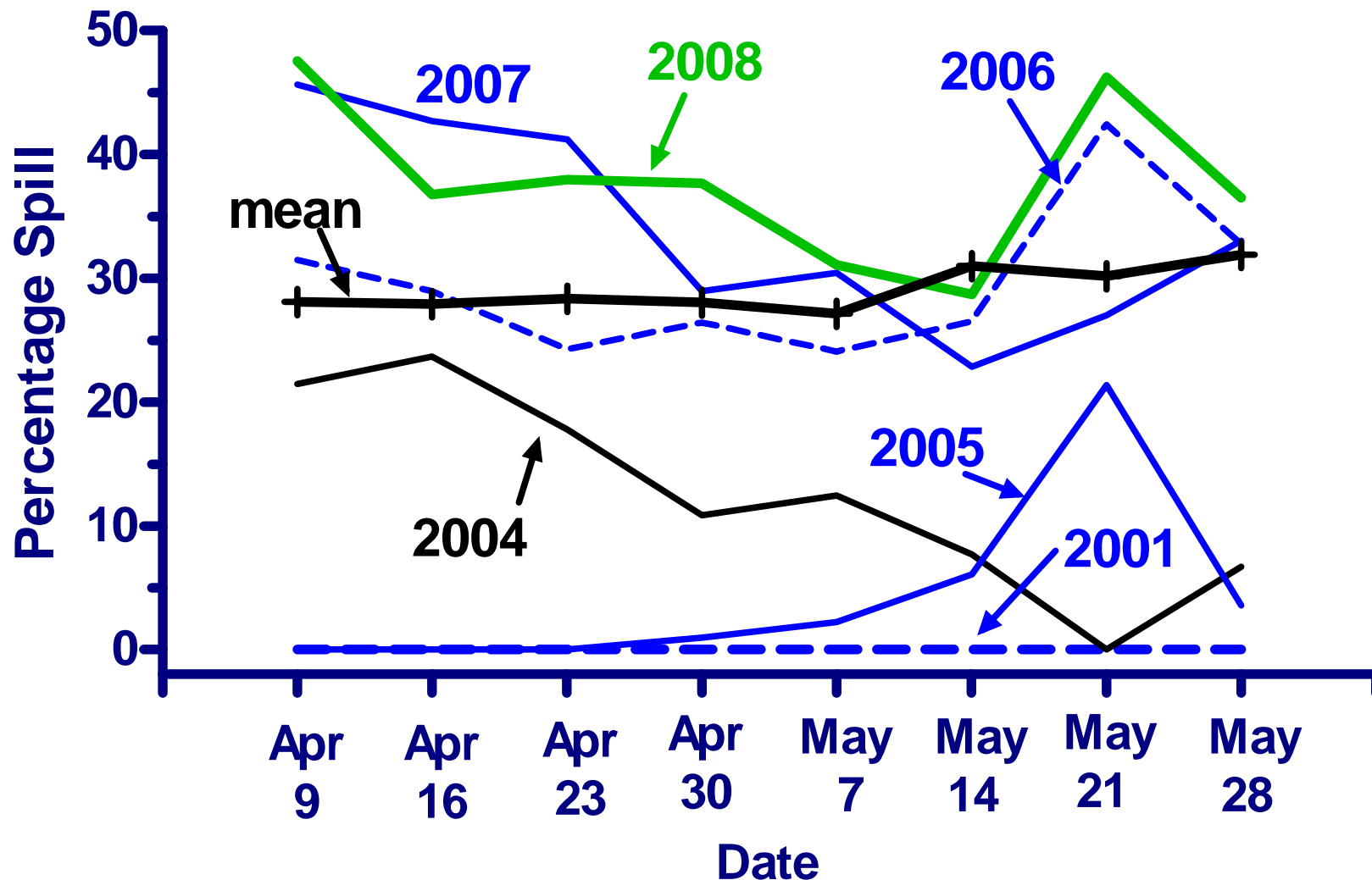
- **Data problem in lower river in 2008?**
- **Spill, Size of In-River Population, and Survival**

# Survival and Travel Time for PIT-tagged Spring Migrants

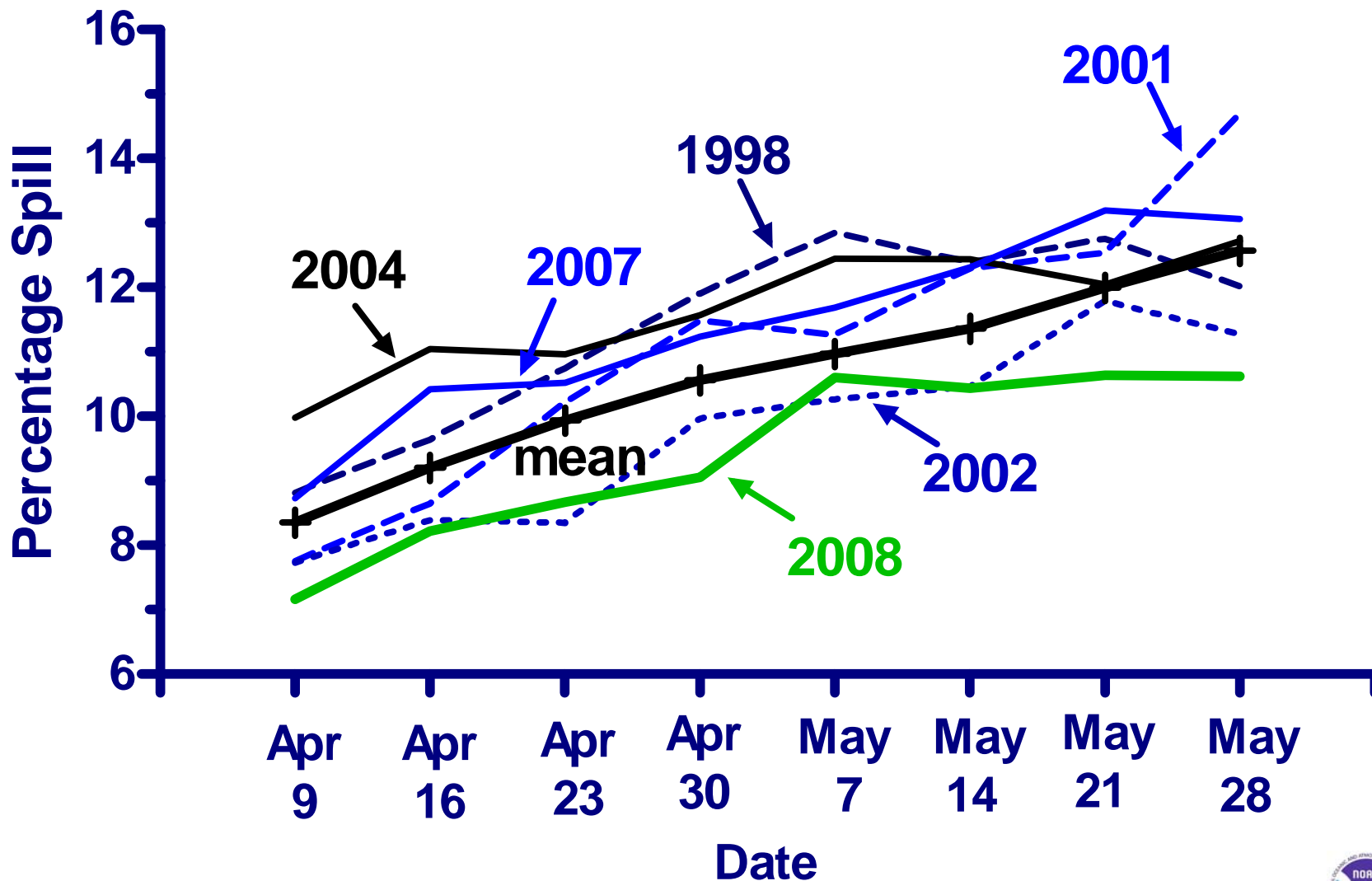
# Weekly Mean Flow (kcfs) Lower Granite Dam 1997-2008



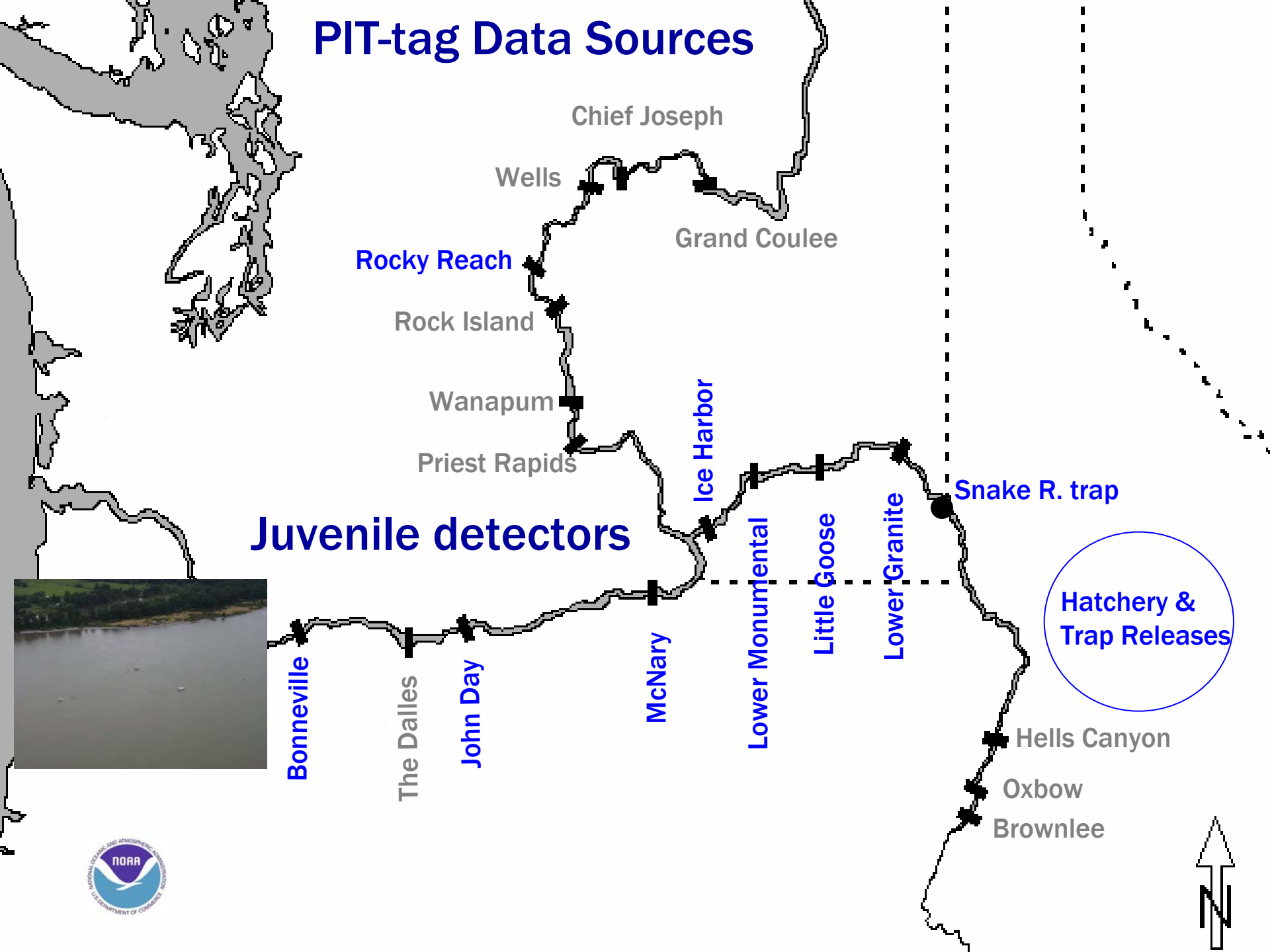
# Weekly Mean %Spilled LGR, LGS, LMN 1997-2008



# Weekly Mean Temperature Little Goose Dam 1997-2008

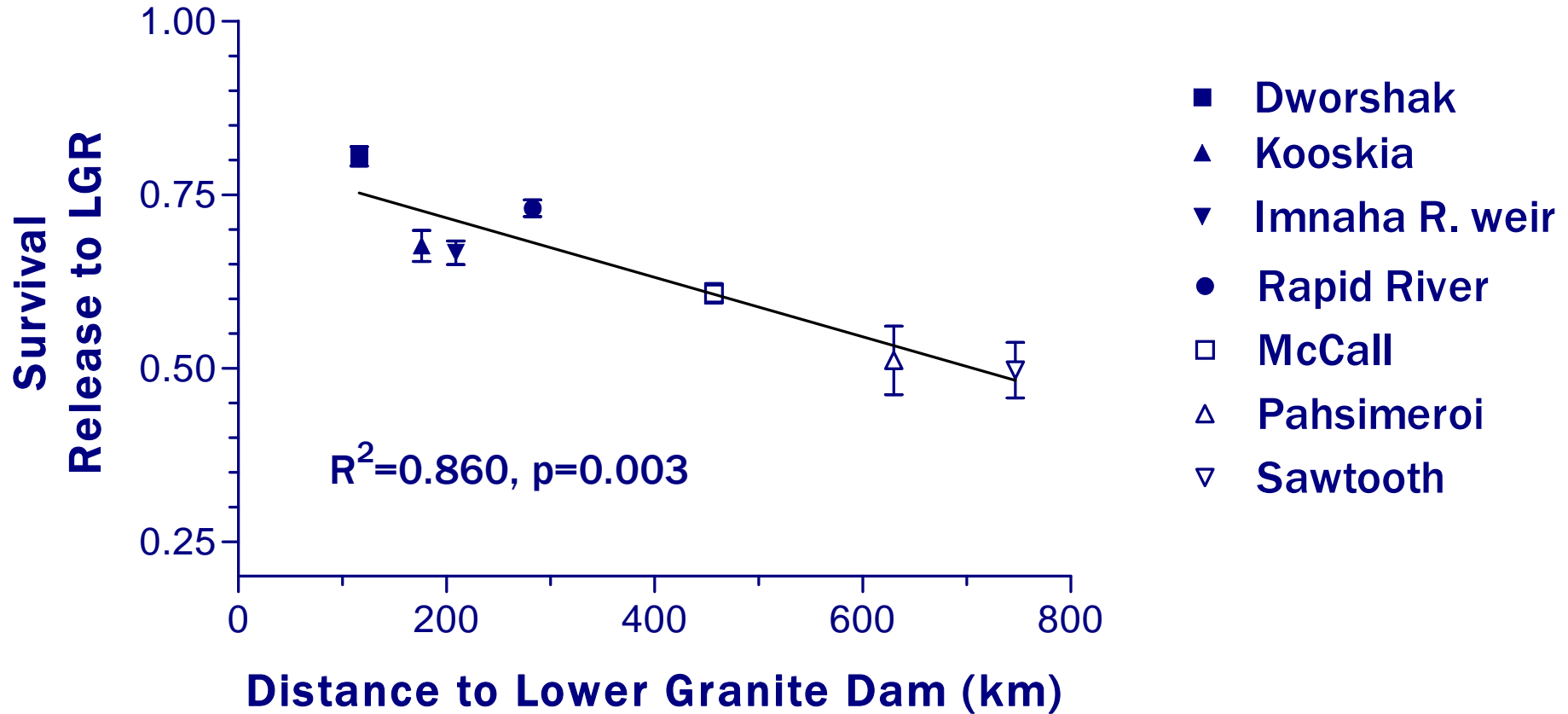


# PIT-tag Data Sources

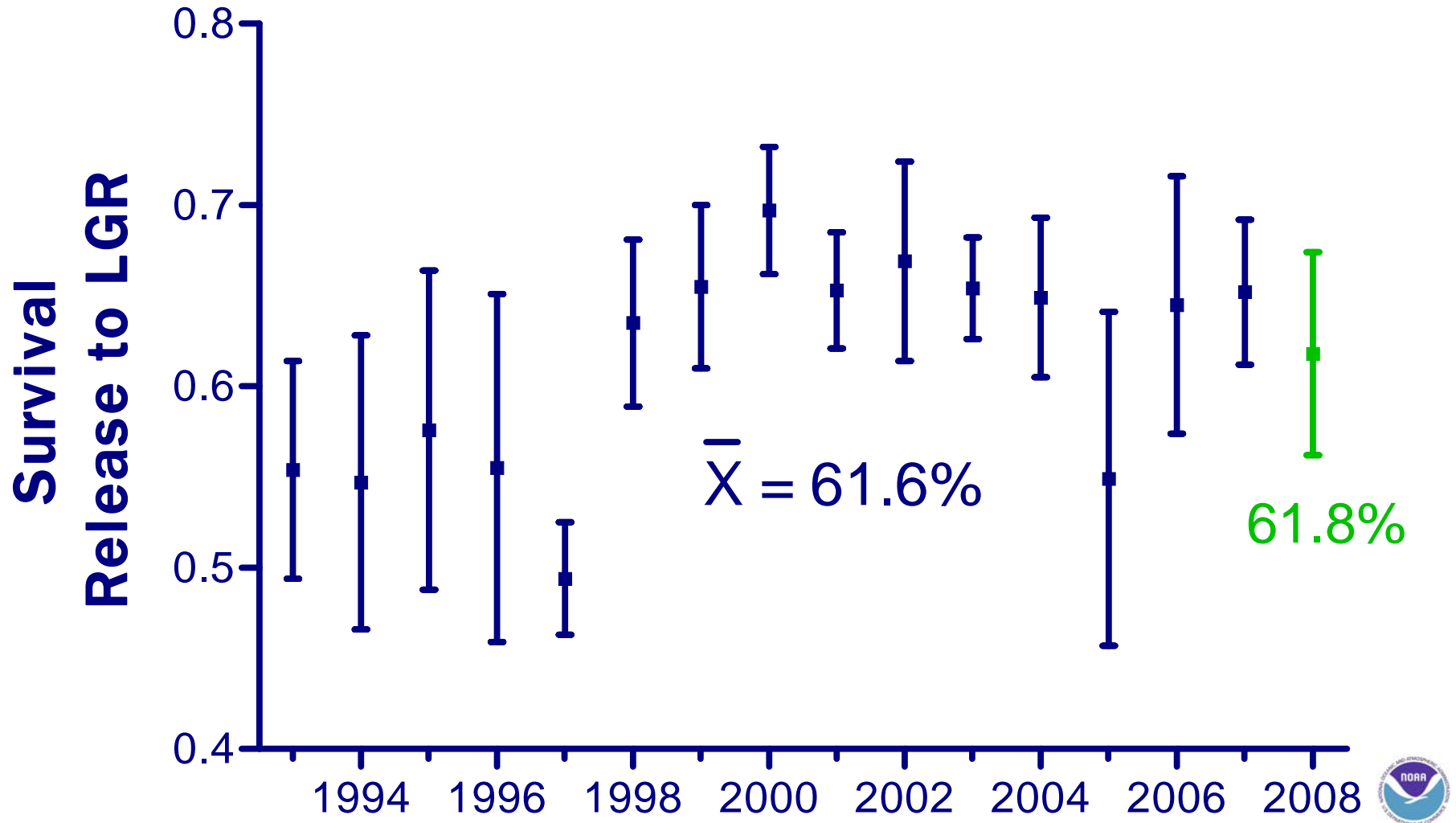




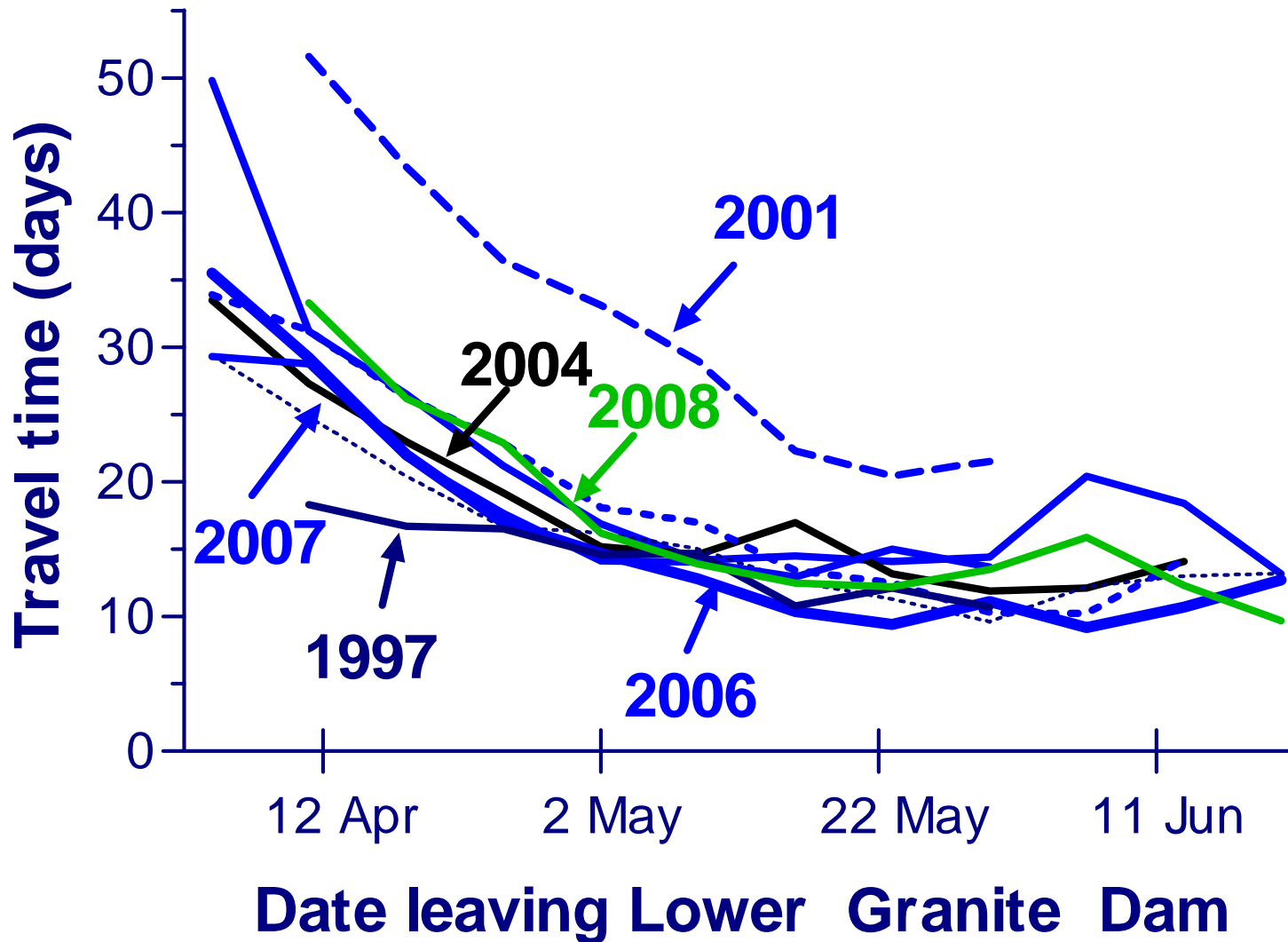
## Hatchery stream type Chinook (1998-2008)



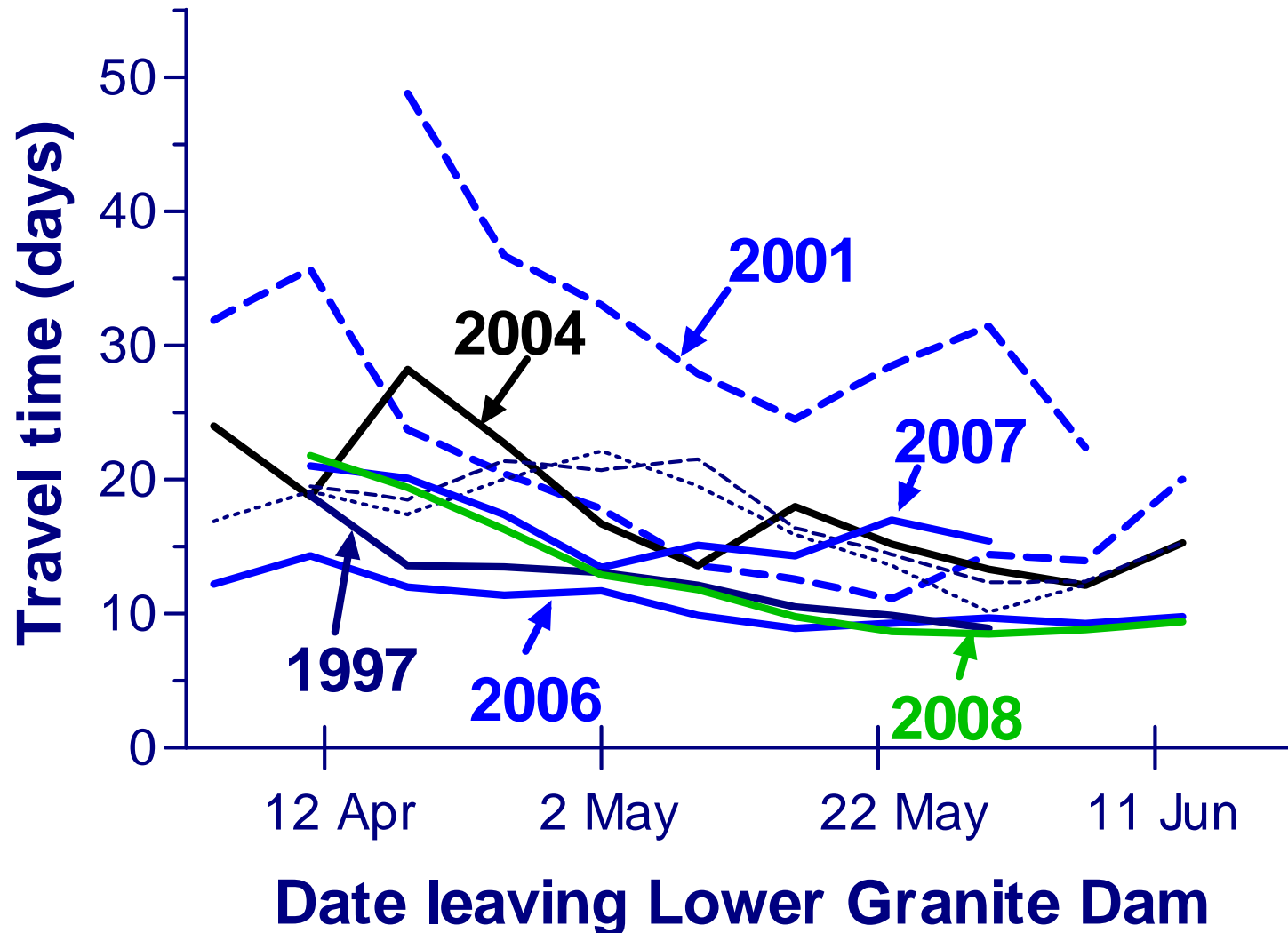
# Stream type Chinook Snake River Basin Hatcheries Mean of index groups



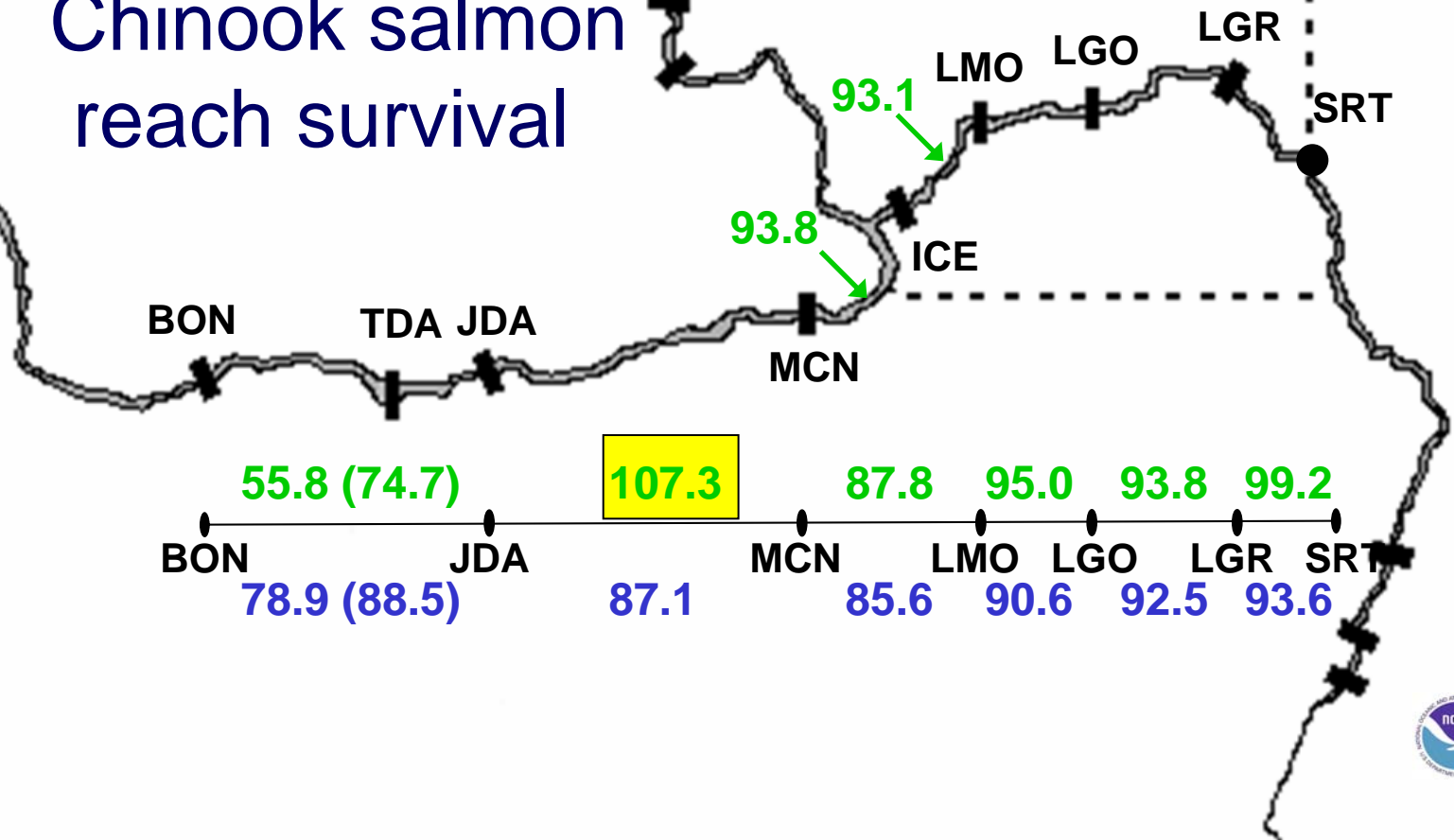
# Stream-type Chinook median travel time Lower Granite to Bonneville (461 km)



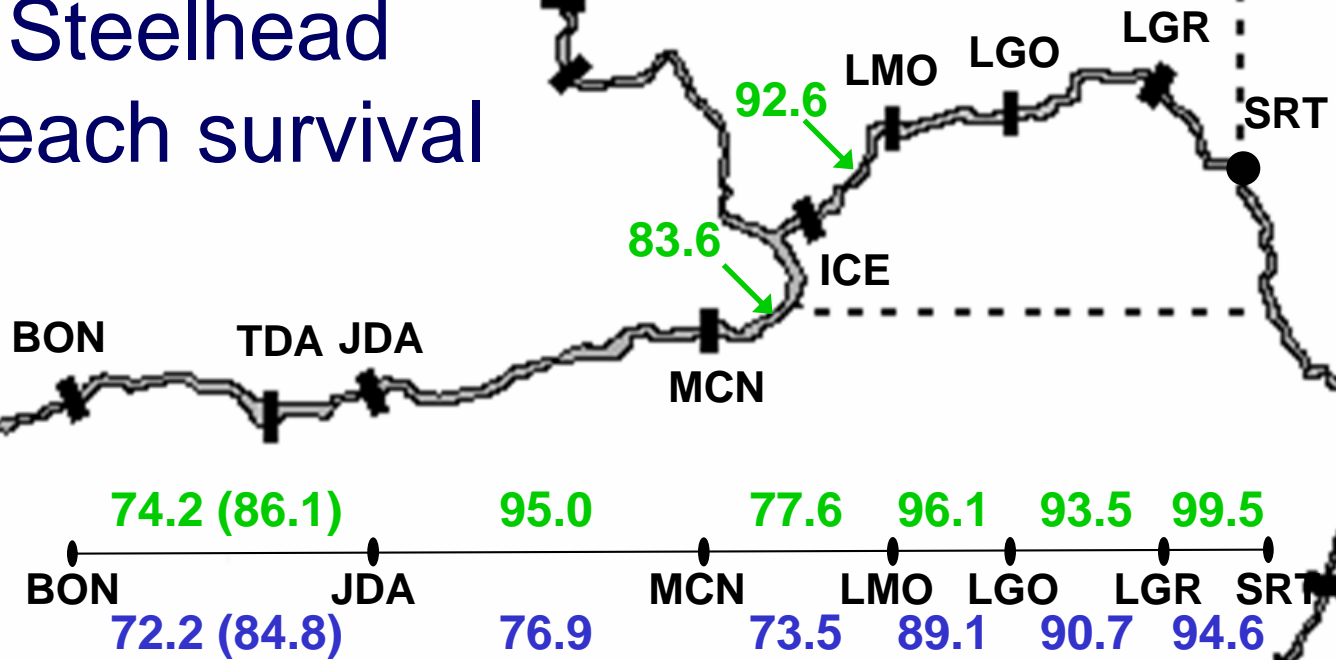
# Steelhead median travel time Lower Granite to Bonneville (461 km)

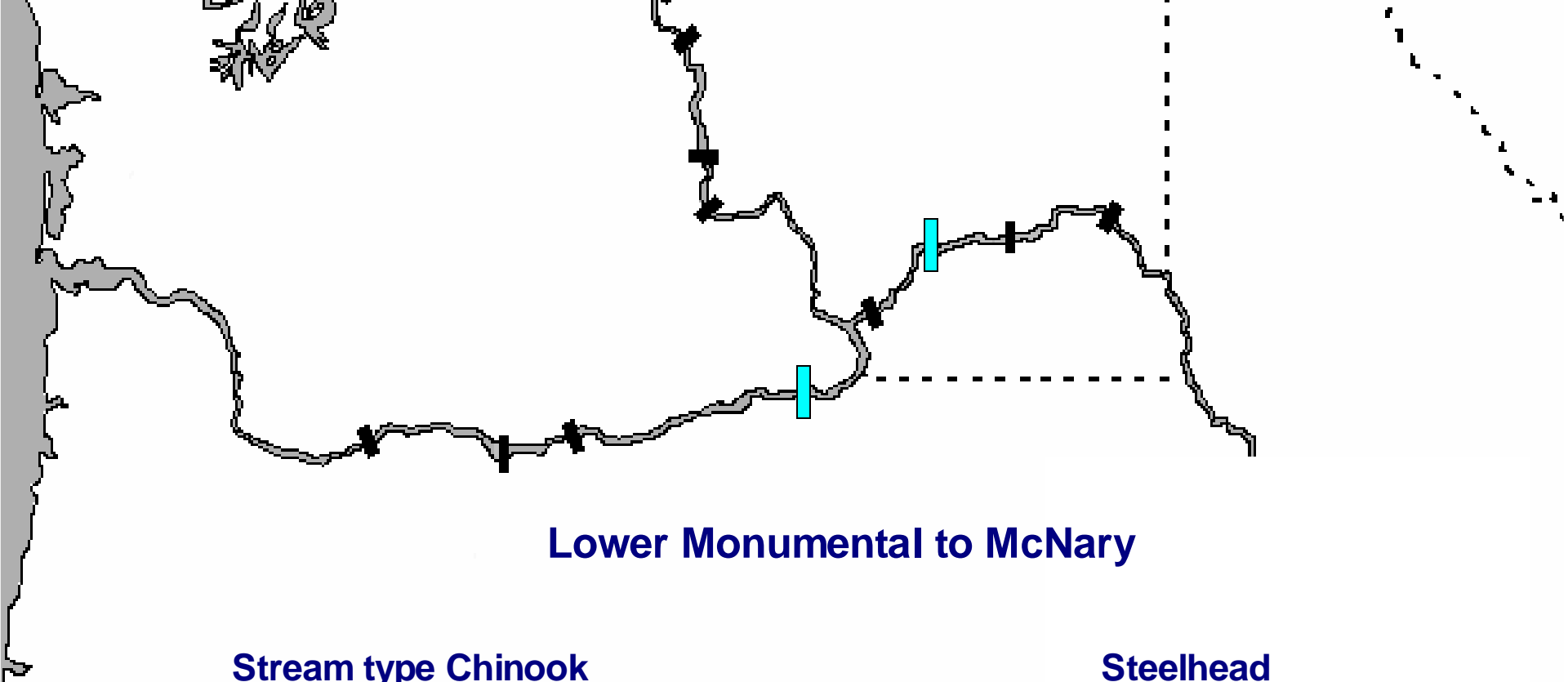


# Stream-type Chinook salmon reach survival



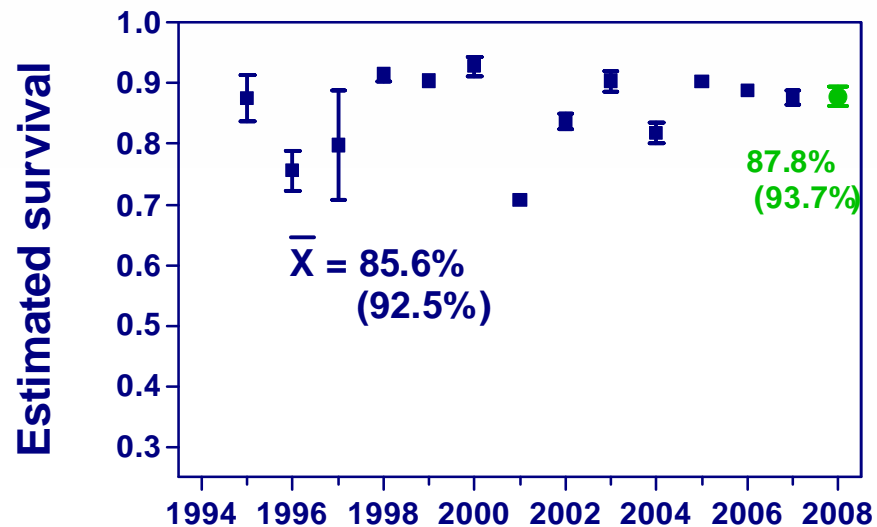
# Steelhead reach survival



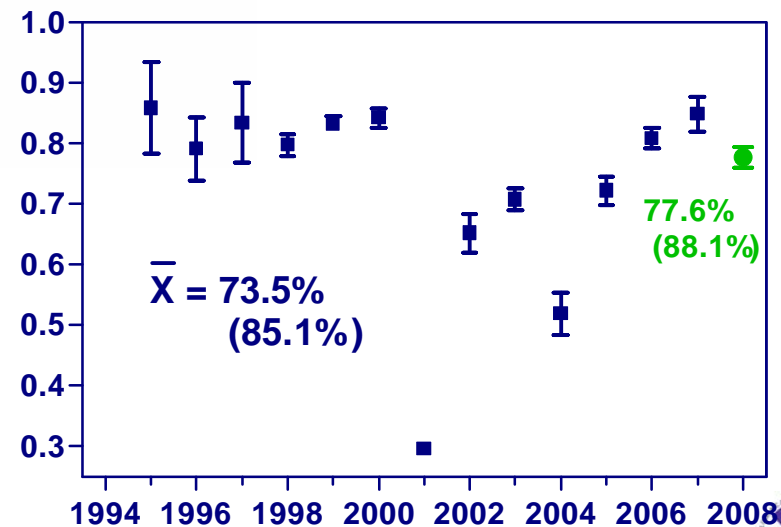


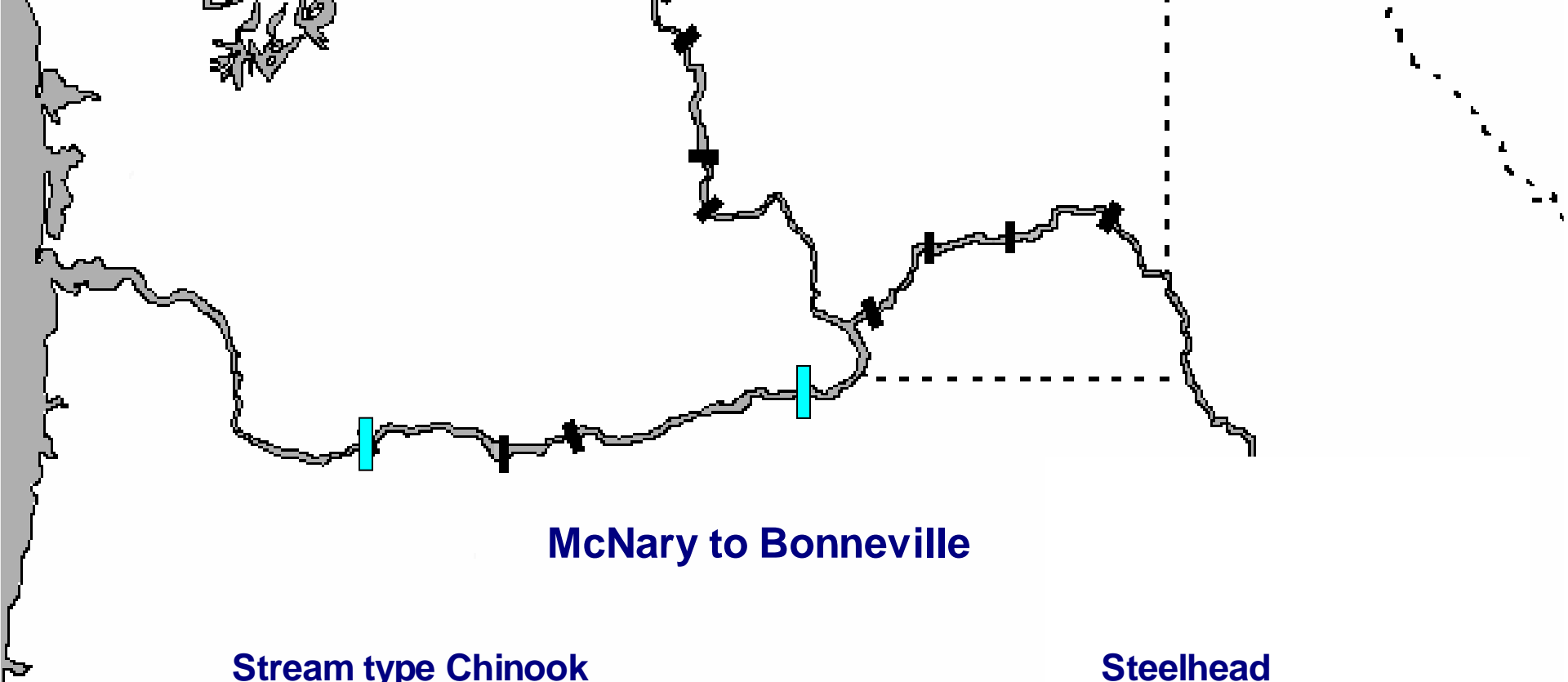
## Lower Monumental to McNary

### Stream type Chinook



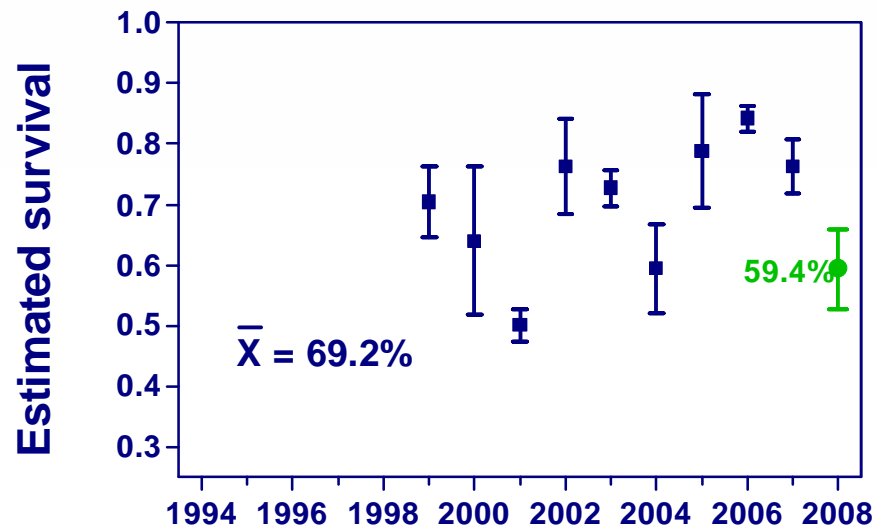
### Steelhead



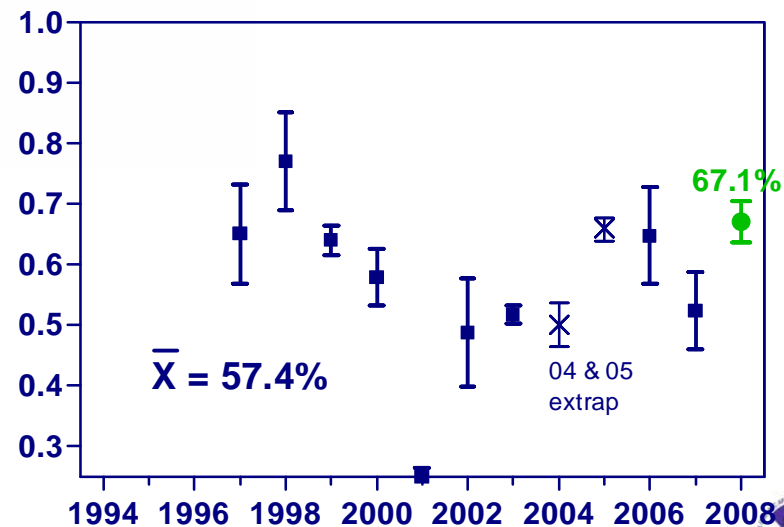


## McNary to Bonneville

### Stream type Chinook



### Steelhead







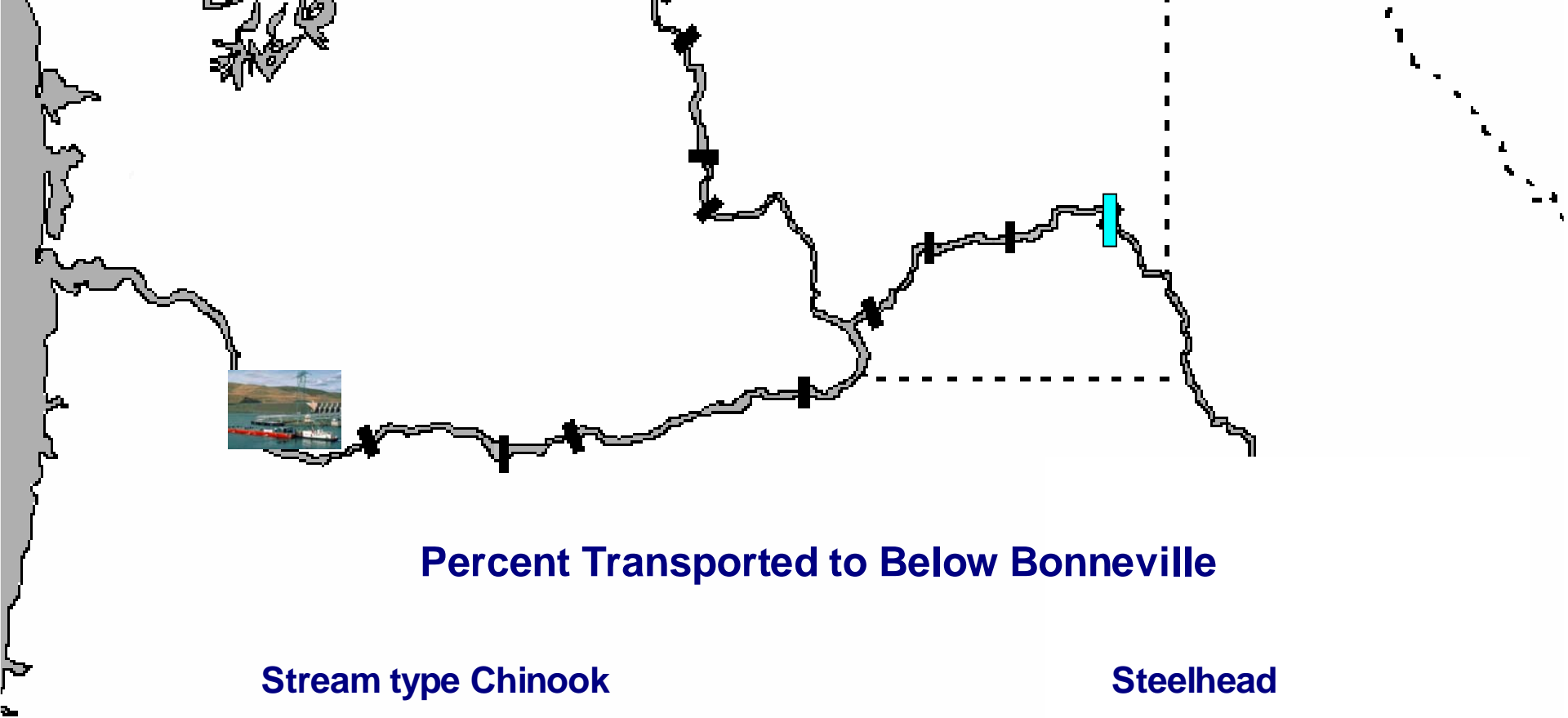
# Percentage of fish transported



# Percentage of non-tagged fish transported

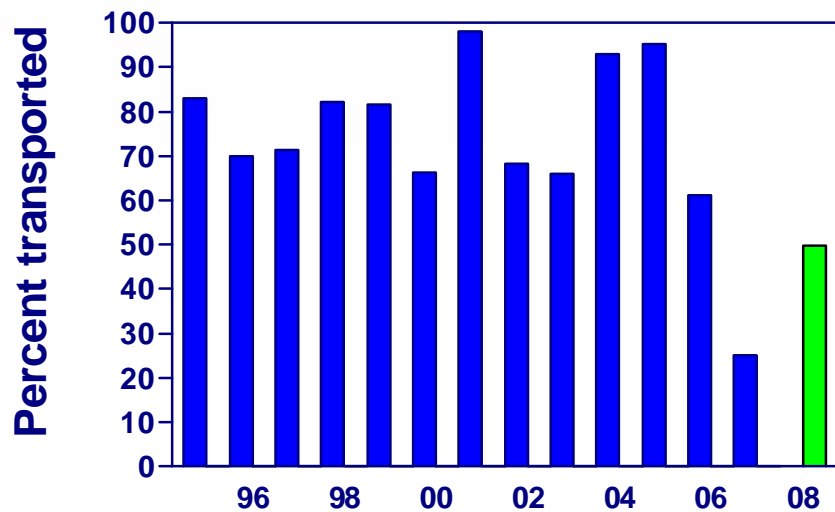
Preliminary estimates for 2008 based on  
PIT-tag data:

- 54.3% wild Chinook
- 45.3% hatchery Chinook
- 50.5% wild steelhead
- 46.6% hatchery steelhead

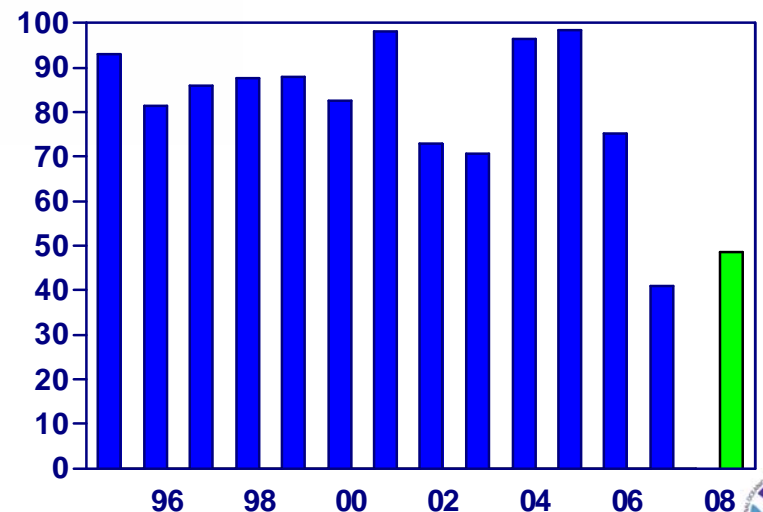


## Percent Transported to Below Bonneville

Stream type Chinook



Steelhead

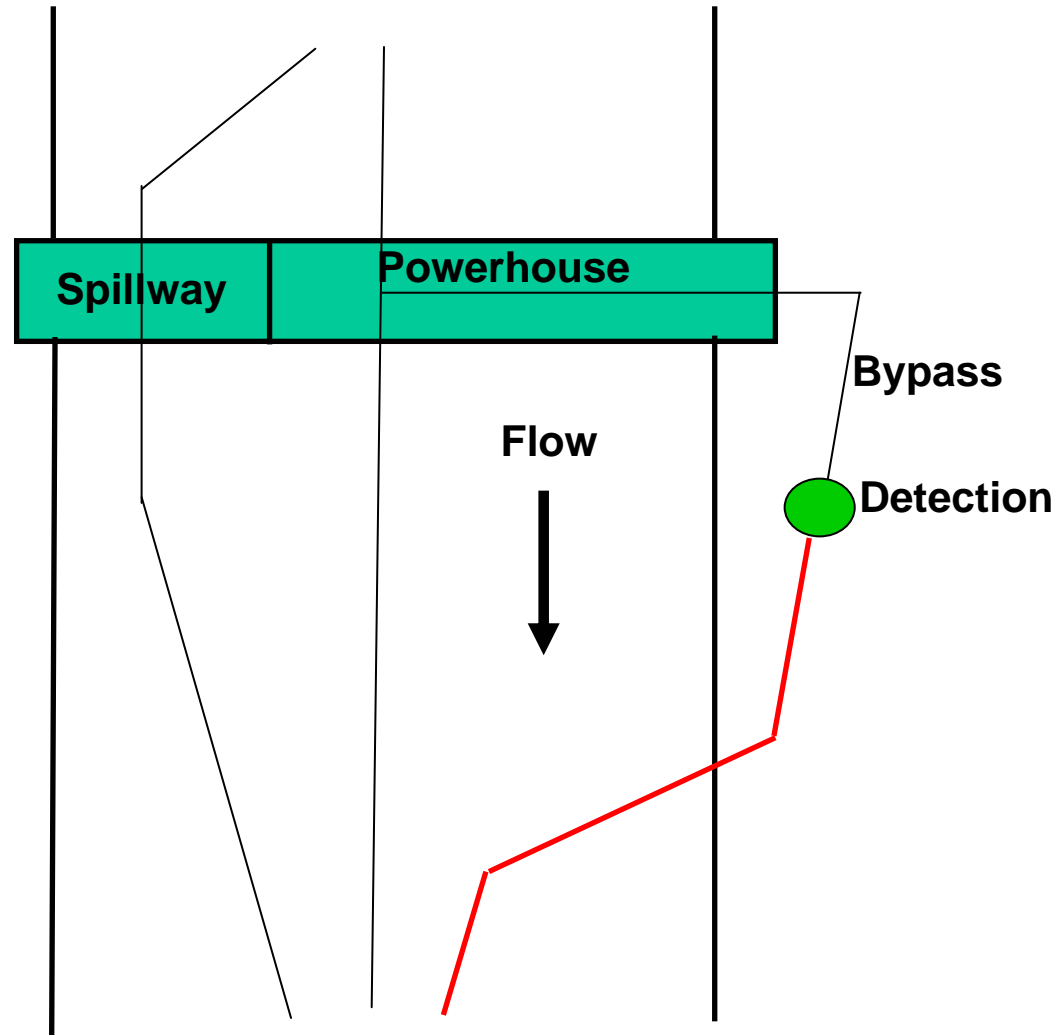


# Data problem in lower river in 2008?

Table 2. Estimated survival probabilities for Snake River yearling Chinook salmon (hatchery and wild combined) detected and released to the tailrace at McNary Dam in 2008. Daily groups pooled weekly. Estimates based on the single-release model. Standard errors in parentheses. .

Date at McNary	Number released	McNary to John Day Dam	John Day to Bonneville Dam	McNary to Bonneville Dam
27 Apr–03 May	588	1.103 (0.190)	0.507 (0.167)	0.559 (0.156)
04 May–10 May	7,576	0.983 (0.054)	0.761 (0.080)	0.748 (0.067)
11 May–17 May	24,299	1.195 (0.060)	0.379 (0.036)	0.453 (0.036)
18 May–24 May	13,541	1.175 (0.099)	0.682 (0.189)	0.802 (0.212)
25 May–31 May	3,244	0.731 (0.084)	NA	NA
01 Jun–07 Jun	1,239	0.962 (0.164)	0.795 (0.544)	0.764 (0.507)
08 Jun–14 Jun	716	0.747 (0.202)	0.640 (0.606)	0.478 (0.434)
<b>Weighted mean*</b>		<b>1.073 (0.058)</b>	<b>0.558 (0.082)</b>	<b>0.594 (0.066)</b>

# Post-detection bypass (PDB) mortality



# Data Effects of PDB Mortality

- Detected at dam 1 = Counted alive in tailrace, but actually dead
- Too few detected fish show up at dam 2
- Dam 1 detection probability underestimated
- Reach 1 Survival probability overestimated

# Data Effects of PDB Mortality

- Effect on Reach 2 survival estimate depends on Dam 2:
  - If no PDB mortality at Dam 2, Reach 2 survival is underestimated, *but combined Reach 1 & 2 survival is unbiased*
  - If PDB mortality at Dam 2, effect is uncertain



# Lower River Conditions

- MCN-JDA and JDA-BON estimates affected by PDB mortality, but MCN-BON ok?
  - MCN-BON estimate lower than average for Chinook

# Increased Avian Predation?

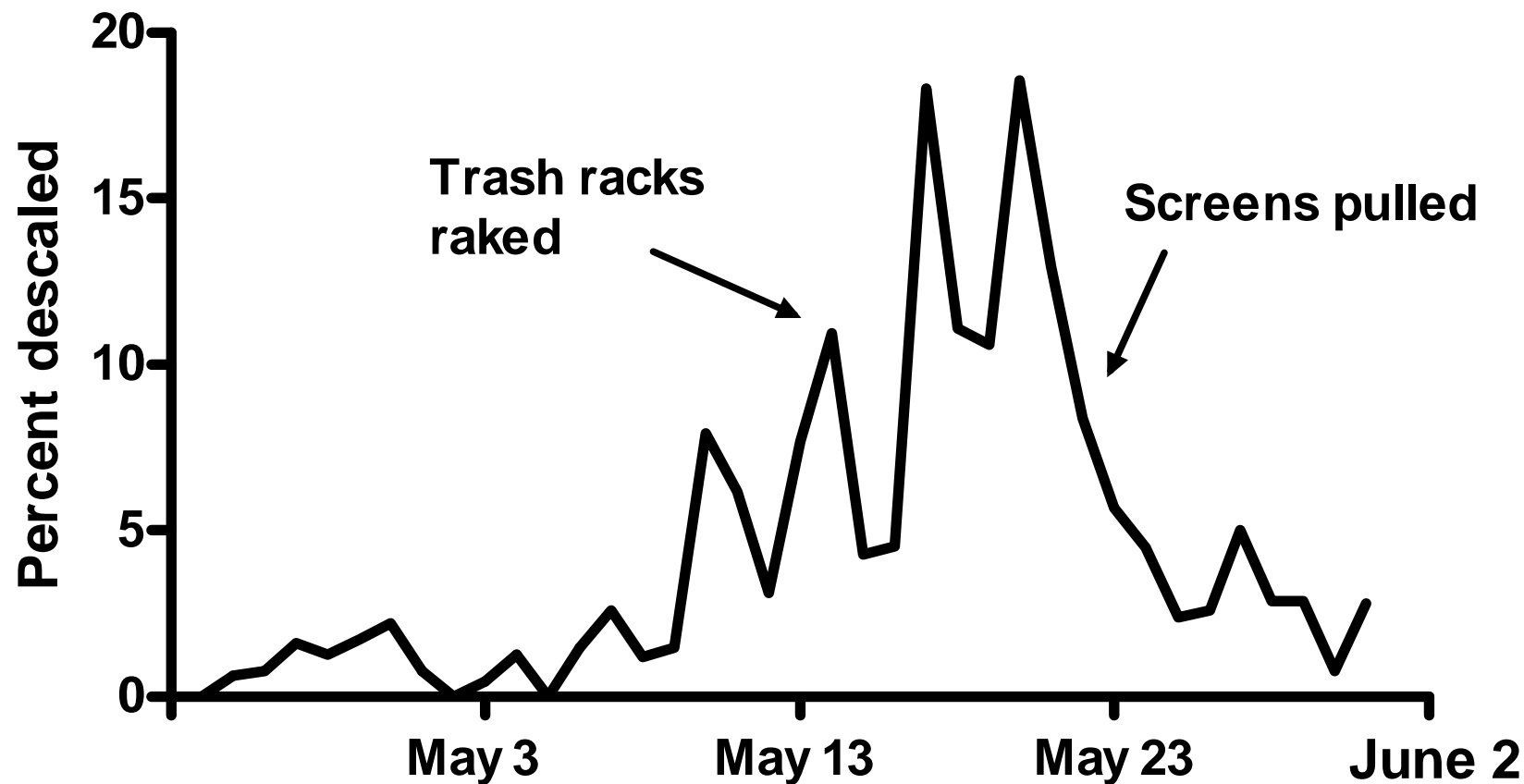




# Debris on Screens at Bonneville Dam?



# Bonneville Dam Yearling Chinook salmon





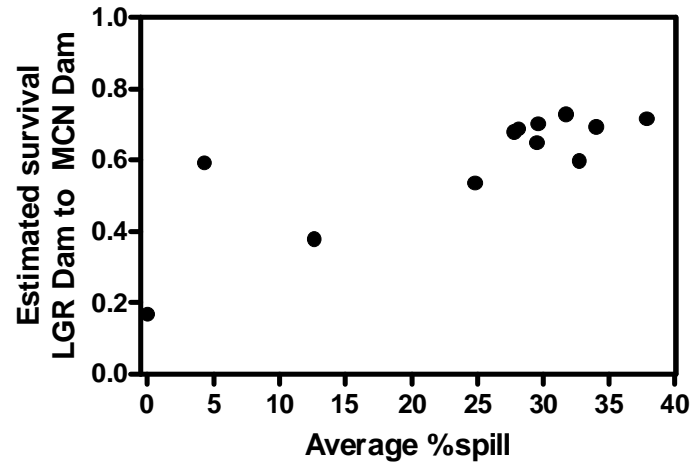


# Spill, Transport, In-River Population Size, and Survival

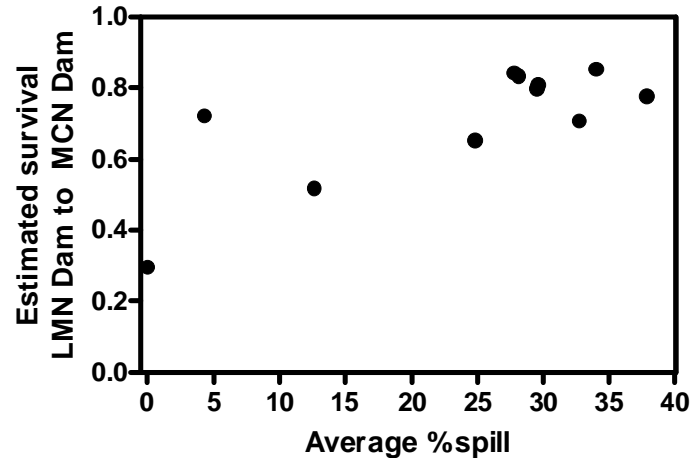


# Steelhead Survival & Spill%

Survival LGR-MCN

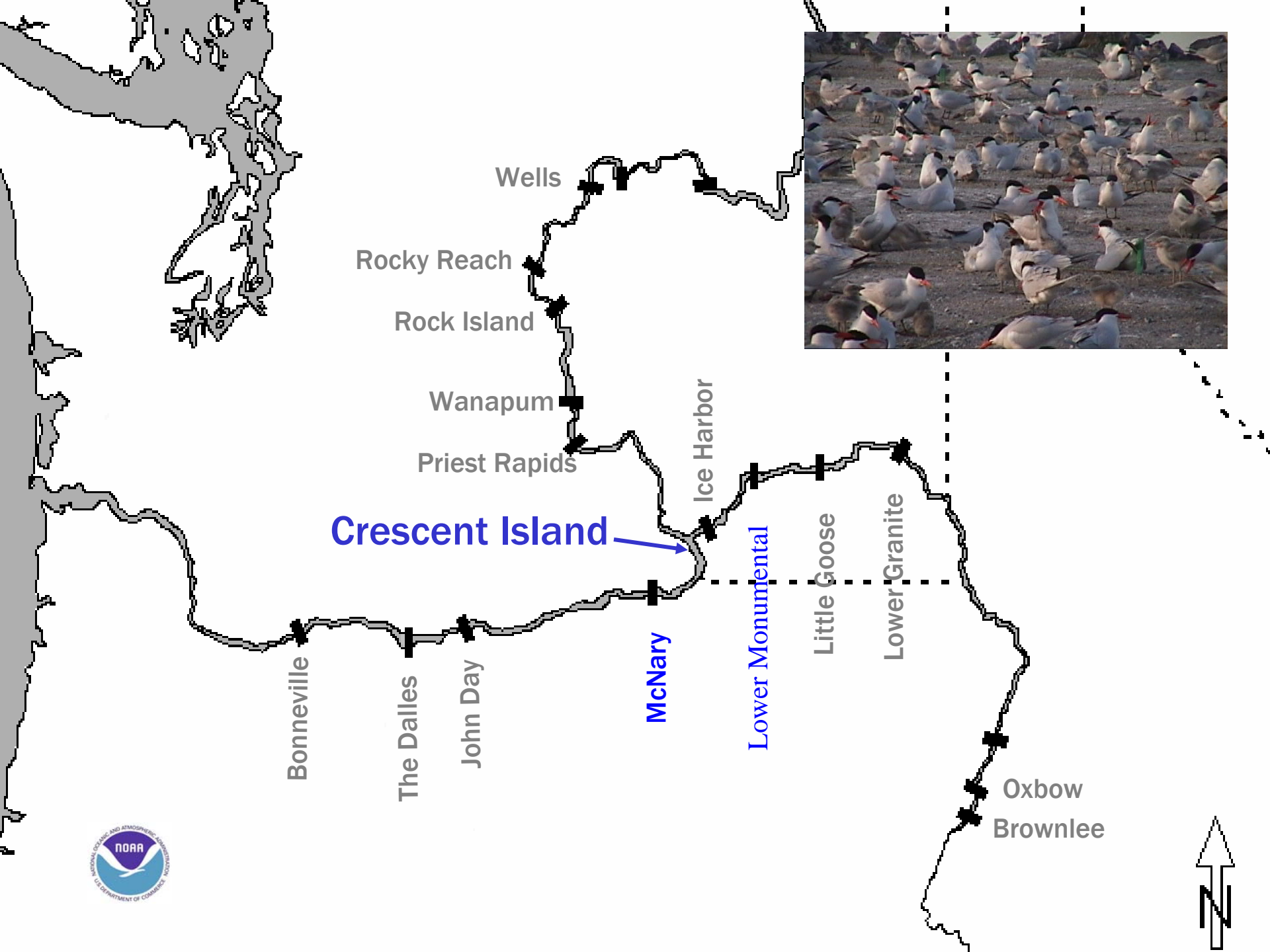


Survival LMN-MCN



# Passage-Route Survival Spill vs. Bypass

- Recent radiotelemetry studies
  - Little Goose 2005-2007
    - spill & bypass both > 95-96%
  - Lower Monumental 2007
    - spill 93.9%, bypass 98.6%
  - Ice Harbor
    - spill 96-97%, bypass 97-98%



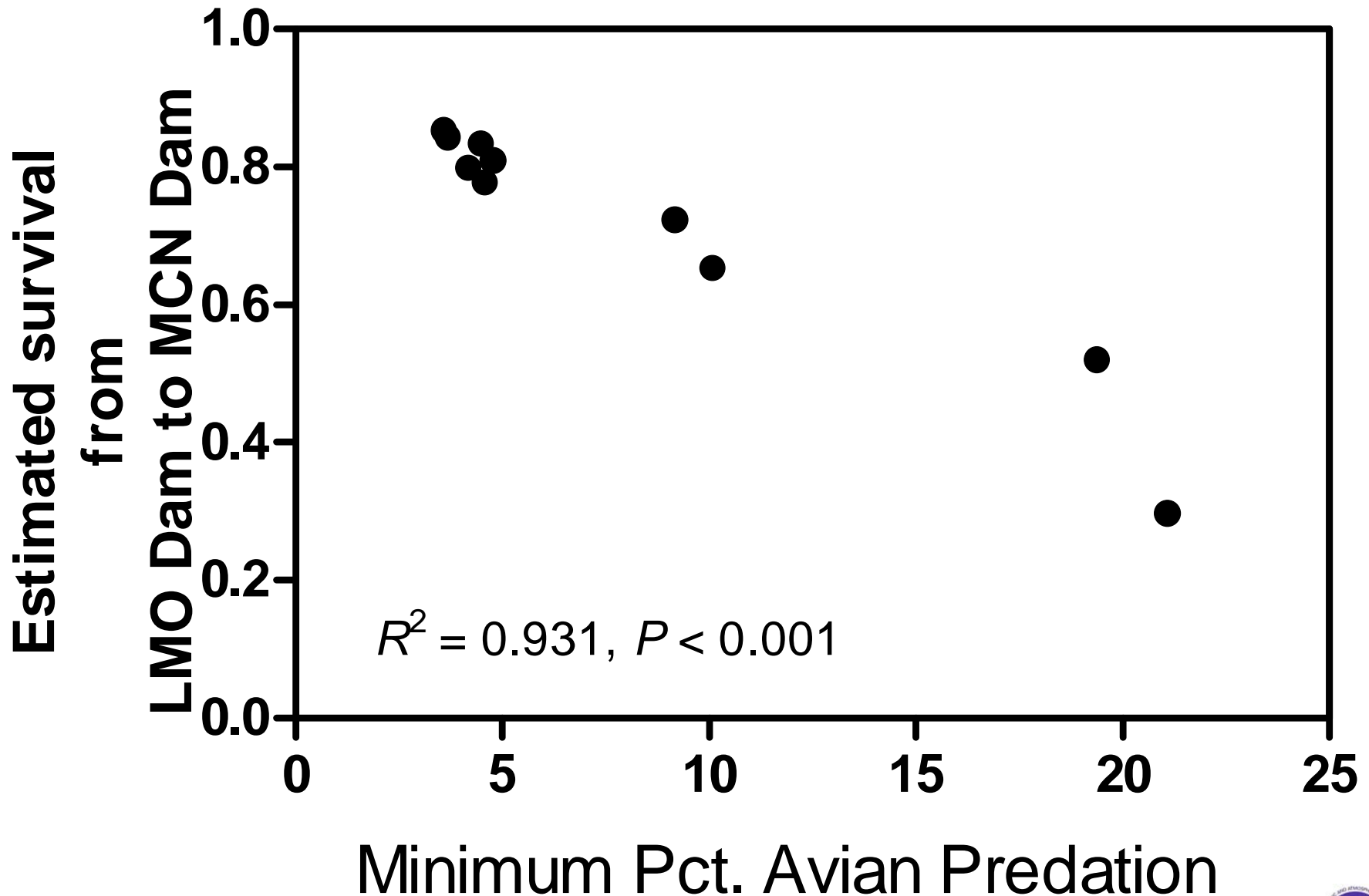


# Minimum Estimate of Steelhead Mortality from Avian Predation

- Percentage of PIT-tagged steelhead detected at LMN eventually recovered on nesting colonies

1998	4%	2004	19%
1999	5%	2005	9%
2000	4%	2006	5%
2001	21%	2007	4%
2002	10%	2008	5%
2003	4%		

# Steelhead

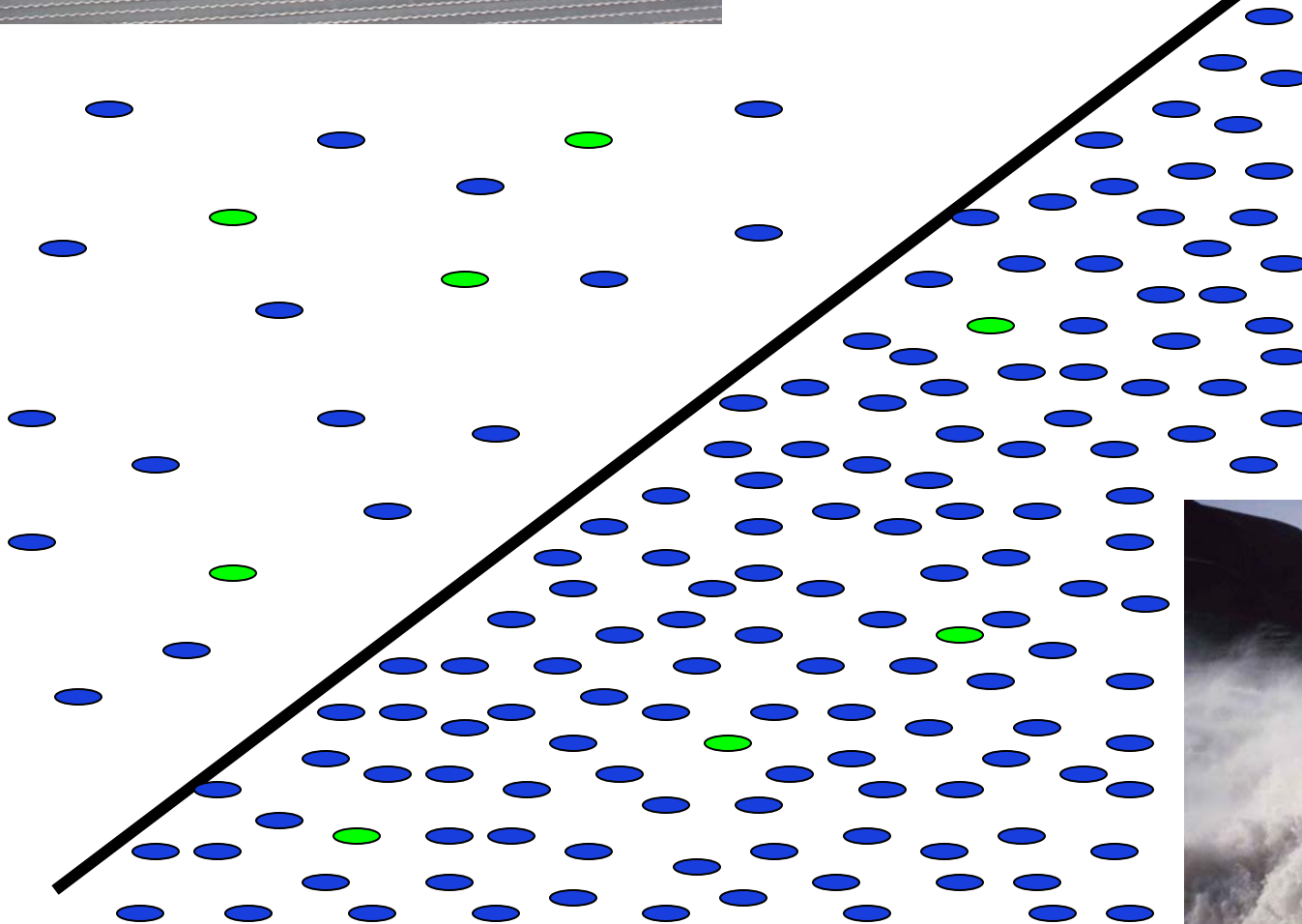


- Total take by birds depends more on number of birds than on number of smolts
  - Size of nesting colonies relatively stable year-to-year compared to number of in-river smolts

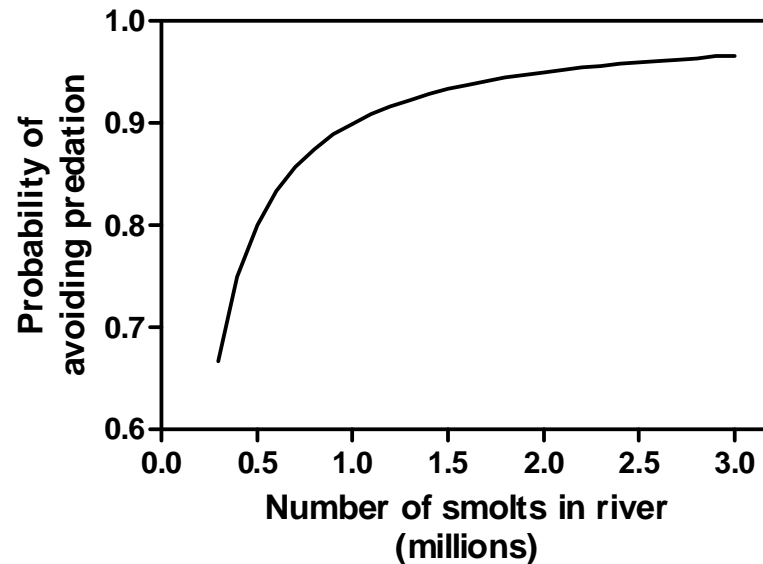
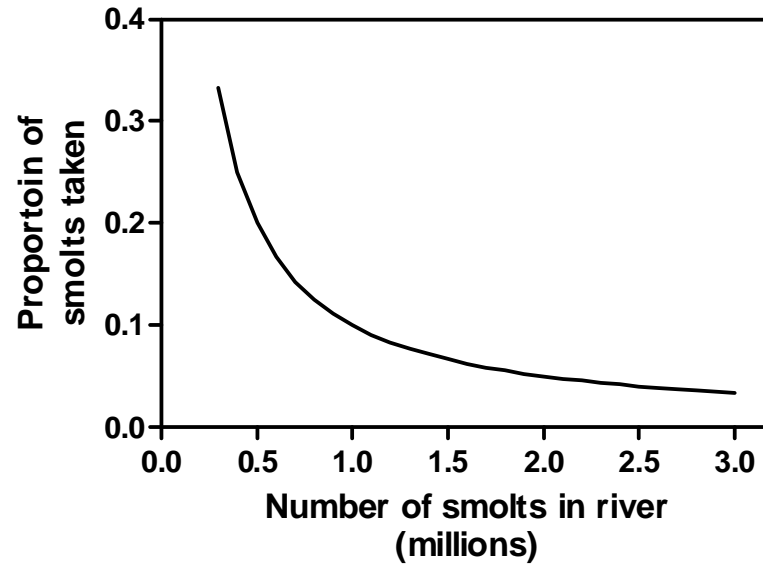


**Maximum  
transport**

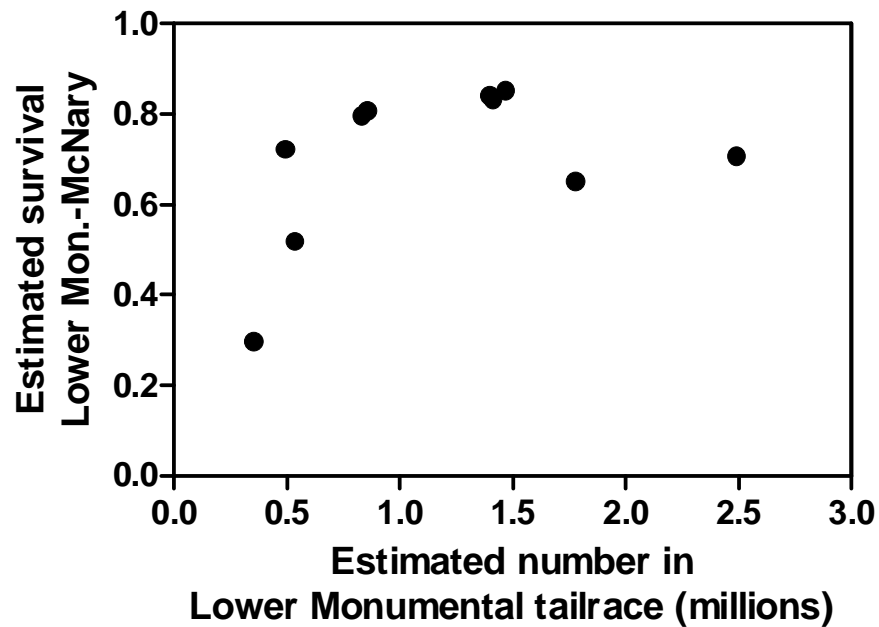
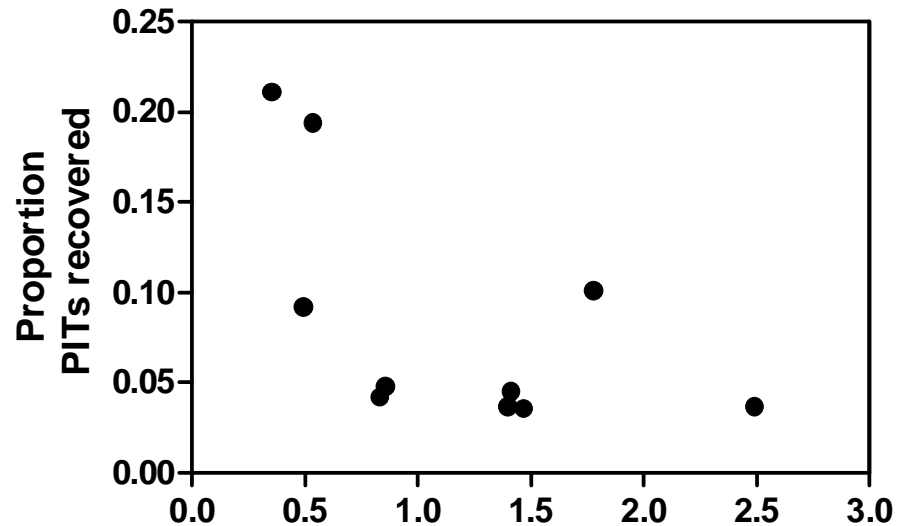
**Transport  
with spill**



# Idealized Relationships



# Steelhead Data



# Conclusions

- In low-spill (high transport) years, lower survival results, in part, simply from fewer fish in the river

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  - In-river survival would have been higher if bypassed fish had been returned to the river



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- In low-spill (high transport) years, lower survival results, in part, simply from fewer fish in the river
  - In-river survival would have been higher if bypassed fish had been returned to the river
- Converse is also true: in-river survival increases with increasing spill through indirect effect of reducing individual vulnerability to predation

# Conclusions

- Direct or indirect effects of increased spill may not improve smolt-to-adult survival for the population

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- Direct or indirect effects of increased spill may not improve smolt-to-adult survival for the population
  - Cumulative effect must offset effect of transporting fewer steelhead



Questions